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Pressure predictions of Darcian flow in non-uniform media

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The work presented concerns laminar flow through a porous media whose pore length scales vary in the direction of bulk fluid flow. The goal is to be able to predict local pressure and flow data without having to explicitly solve the creeping flow problem. In this study, an empirical model is developed to estimate the local permeability as a function of local pore length scale. The constants empirical relationship can be developed from the data of as few as 4 numerical simulations (each using a different set of length scales). The result is that the local pressure and bulk flow velocity at any point in the media are able to be predicted with only knowledge of: the media geometry, the fluid viscosity, and the total pressure drop over the media. The results of the predicted pressure field agree with those of the numerical simulations within 2.5%.